



Forensic Building Science, Inc.

Supplemental Report

for

Bethany Medical Center
6801 NW 39th Expressway
Bethany, OK 73008



February 26, 2013

Brian Craig Johnson

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Licensed Professional Engineer
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Oklahoma Certificate of Authority #6435

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Client:

Arguello Hope and Associates, P.L.L.C.

Project Address:

Douglas Brant/Bethany Medical Center
6801 NW 39th Expressway
Bethany, OK 73008

Oklahoma County.

Insurer: State Farm Insurance Company, Policy # 96-C9-7533-9.
Claim #: 36-F506-026.

SUPPLEMENTAL LOSS INVESTIGATION

1.0 Background Information:

1.1 Forensic Building Science, Inc. was contacted by Arguello Hope law firm to provide a destructive inspection of the roof of the above-mentioned property to ascertain the extent of damage caused by a storm, which was reported to have occurred on or around May 16, 2010.

This report is supplemental to a previous report, see that report for related information.



Site Map

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Notes:

Weather report for February 19, 2013 indicates no significant precipitation for the six days prior to the site visit.

Weather report for March 12, 2012 indicates 0.65" of rain the day before.

Weather report for May 16, 2010 indicates 0.98" of rain two days before.

1.2 Forensic Building Science personnel present at this inspection (Feb 19, 2013):

- Brian Johnson, P.E. Haag certified roof inspector – commercial #201201202.

File Notation: Subject Property was visited on August 15, 2012 by Tom Irmiter

1.3 Condition of Roof

At the time of our inspection, one area by cuts #1 and #2 had a relatively small pool of ice and water. Another pool was located toward the back elevation from this area. The remainder of the roof was clear of water pools. This situation is improved from previous site visit.

- Granule on this roof number 2 (area of Cut 4) was broadcast on the built-up roof. Some loose granule is noted in this area. Granule does not appear to have migrated due to wind.
- Leaks in the roof assembly.
- Storm impacts – such as direct damage to AC units.
- Debris on roof in several areas.
- Evaporation zones noted on three roof areas (upper surface on original structure has an interior drain, no evaporation zone noted here).
- Impact damage in perimeter of some evaporation zones.
- Temporary repairs on going.

1.4 The roof is divided into four separate areas, two are newer construction (according to the Owner, Dr. Brant). The original building is wood deck, wood joists, and CMU bearing walls. The newer (addition) is LWIC on metal deck, open web steel joists on structural steel and/or exterior CMU bearing walls. Roof slope is visually flat in all areas except older "pop-up" roof with an interior drain. Exterior perimeters are minimal with roof canters under the surface adjacent to the perimeter (essentially a nominal 2" gravel stop).

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Skylights

1.4.1 There is one skylight on the older building roof number 3, located approximately ten feet from Cut #1.

Exterior AC units and other roof penetrations

1.5 Damage to AC units is a mix of damage from hail, and apparent mechanical and installation damage.

1.5.1 Impact-damaged roof vents substantiate hail. Other heavier gauge roof vents (heavily corroded) are not impact damaged.

Interior damage

1.6 The degree of finish on the interior includes:

- Interior painted gypsum board walls and acoustic ceiling tiles.
- Carpet.

1.7 Damage to interior finishes including ceiling tiles, gypsum board and painted surfaces and roof deck substrate, both wood and LWIC that are a direct result of water intrusion from above.

1.8 Additional referenced documents

- GAF Roof Design Considerations, date unknown, http://www.gaf.com/Commercial_Roofing_Systems/Roof_Design_Considerations.pdf, retrieved 12-9-12.
- 2009 International Existing Building Code, effective Nov 2, 2012.

1.9 Inspection notes:

Roof:

- Significant repairs to roof. Repairs are temporary in nature.
- Repairs are typically at (field) seams, edges and larger impact hits in the field.
- Repairs are ongoing in nature and have not solved leaking issues.
- Roof leaked after thaw and rain prior to our visit.
- Some air-conditioners and access hatches are too close to exterior walls and will require guards (or relocation).

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- Replacement ceiling tiles used for temporary repairs may not be fire rated. Ceiling assembly may depend on a proprietary ceiling tile for the UL rating of the assembly. These tiles are typically more costly.
- Pooling noted to various extents depending on time of year. Several condensate lines for HVAC are routed to an interior drain.
- Some rooftop equipment is closer than 10'-0" from the roof edge.
- Scuppers generally open and clear of debris.
- Interior roof drains, one strainer cover is missing.
- Debris on roof is relatively small size (no large leaves) and would not be expected to clog drains or strainers.

2.0 Roof Cores:

Four destructive inspection cores were performed through all layers of the roof to the wood deck and or LWIC. The majority of the cores were performed at locations that were probable for wetness based on previous site visits. One core was performed at a relative high point, an area with no expected moisture intrusion and no hail damage visible. Locations where the metal structural deck is visible from the interior showed signs consistent with newer shorter term leaking more consistent with the 2012 storm event and an effort to mitigate the subsequent water intrusions. The decks showed little or no corrosion or rust.

Refer to the roof drawing to reference the location of each roof core. Refer to the roof core inspection photo log for photos of each core.

2.1 Roof Core #1 – Vicinity of reported leak below near an interior roof drain, lower roof number 3.

- Flood coat of asphalt applied as temporary patch. Patch is still black.
- Interior water damage reported in the vicinity of this roof core.
- Moisture beneath top surface (mod-bit cap sheet).
- Mod-bit cap sheet torched down to glass felt.
- Felt hot mopped with asphalt onto built-up roof.
- Smooth surfaced built up roof beneath.
- No insulation.
- Nominal ½" fiberboard dry but friable.
- Plywood surface appears dry beneath.
- Darker area on plywood consistent with fungal growth due to water instrusion.

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- 2.2 Roof Core #2 – Damaged roof membrane. Roof number 3 spongy to touch.
 - Mod-bit cap sheet torched down to glass felt.
 - Bulge/puncture in cap sheet.
 - Felt hot mopped with asphalt onto built-up roof.
 - Smooth surfaced built up roof beneath.
 - No insulation.
 - Nominal ½" fiberboard broke apart and delaminated when opened. Material is wet 23% WME.
 - Plywood/plank wet 23% WME.
- 2.3 Roof Core #3 – Upper roof number 1 surface at addition, smooth surfaced. Relative high point.
 - Evaporation zone to East and South.
 - Smooth surfaced mod-bit cap sheet adhered to.
 - Smooth surfaced built up roof.
 - No fasteners.
 - No insulation.
 - Lightweight concrete or zonolite type material beneath.
 - On setting 3 (Gypsum) 9% moisture.
 - On setting 2 (Concrete) 94% moisture (borderline high).
- 2.4 Roof Core #4 – Relative high point, granule covered roof number 2.
 - Area here not bulged or blistered.
 - No sign of drainage of condensate from rooftop units.
 - Many bulges/blisters noted in vicinity.
 - Evaporation zones to rear of building.
 - Granule broadcast onto mod-bit cap.
 - Active water found between top mod-bit cap and built up roof beneath
 - Built up roof beneath.
 - Lightweight concrete or zonolite type material beneath.
 - Sand/sawdust consistency of debris beneath this area.
 - On setting 2 (Concrete) 80% moisture.

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3.0 General Discussion:

3.1 Causation Statement

3.1.1 Based upon evidence collected from the physical inspection and roof core assessment we have concluded that all four roofs are damaged and must be completely replaced. Based upon a reasonable degree of engineering certainty, it is more likely than not that the observed damage is a result of the subject storm event. On the reported date of loss, there was sufficient hail and rain to cause damage to the air conditioners and the roof membranes. Impact damage to membrane and subsequent water intrusion into the building are attributed to hail strikes. Wind from the event may have been a contributing factor at roof edges.

While temporary mitigation efforts by the owner have stopped some leaking, water has simply been diverted into other locations. This is typical of micro-tears in a roofing membrane caused by hail strikes. Failure to replace the roofs will result in additional damage due to water intrusion into both unoccupied and occupied spaces. In our opinion, based on the age of the building and changes to the building and energy codes from the date of original construction to the date of loss, additional costs to repair will be required to meet the current required code or manufacturer's installation instructions for a new roof.

3.2 The following observations supplement previous report findings or amend them:

Revisions:

- Section 1.11 states membrane appears to be draped. Based on physical inspection this area is solid and a cant is present beneath. While draped membrane would be a vulnerable area, it would also tend to be a high point unless near a scupper. Water intrusion is not physically consistent with a damaged, draped membrane at the perimeter.
- Section 1.11 states parapet bracing is required. This is for high seismic zones (SDC D, E, F) and is deemed not to apply, engineer of record to verify.
- Section 3.10 is unclear if guards will be required. The roof edge curb is virtually zero and is not sufficient to serve as a guard if the rooftop units are detached to install curbs, flashing, etc., in a normal roof replacement. In our opinion either rerouting HVAC inside the building or moving the units is the best course of action. Most of the roof edges on this portion cantilever and will not be strong enough for

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reinforcement to install a guard. The proposed reinforcement needed for relocated units would likely be relatively straightforward but would require engineering.

Additional observations:

- Older construction has roof membrane attached to fiberboard that is substantially water damaged or friable from previous wetting, (freezing), and drying. In our opinion the fiberboard is saturated in some areas, dry in others, based on variables in roofing, material thickness, drainage, etc. At least 50% of this material should be expected to be water damaged. While there is some insulation value to fiberboard (approx.. R2.78 per inch of thickness), it is currently wet in areas which nullifies the insulation value. The fiberboard itself is not enough to meet current codes if the entire roof is removed (i.e. removal and replacement is Alteration, Level 1 in IEBC. While 100% of the material is proposed to be removed, Per International Existing Building Code, page vi, Chapter 8, Alterations, Level 3, states: "Level 1 alterations do not involve space reconfiguration." Alterations, Level 1 are required to conform to current building, plumbing, mechanical, electrical, and energy conservation codes. Per Section 607, only the alteration (in this case, the roof and AC units) are required to conform to the energy code requirements of the International Energy Conservation Code.
- Newer construction does not have above the deck insulation. Metal deck is not fire-proofed. Current energy code will require insulation in this area (i.e. Zone 3A, R-20 equivalent). Tapered insulation will also be required to meet code and/or manufacturer's requirements for slope/drainage. Changes to thickness for insulation will require rework of perimeters to match height and allow install of flashing for a complete roof system.
- Sizing of interior drains and overflow scuppers should be verified by a mechanical engineer.
- Based on the water damage to ceiling tiles inside the buildings, it is our opinion that the entire roof is compromised (area of roof cuts 1, 2, 3, 4). Roof number 3, in cuts 1, 2 has greater pathways for water once the membrane is breached. The other roofs are effectively storing water in the LWIC, causing it to crumble. Leaking downward through the LWIC will eventually occur.
- Hail report for this date was reviewed (see attached). Diameter of hail (estimate) in this area is 1" +/-.
- Loss to the roof system service life and water resistive properties is correlated in time to the storm date by Owner.
- Damage to roof is unrealistic to trace to individual damage locations, patching is ongoing even now. This demonstrates an inability to practically maintain the roof in a manner similar to the maintenance program in place prior to the storm event. The majority of the repairs are in the field, consistent with a damaged membrane and have had some success.

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- Wrinkling and blisters of roof membrane consistent with water vaporizing under the top surface of the roof membrane. As water vapor has a volume about 1,500 times that of water, it can cause blisters when the vapor is not able to escape the membrane. Wrinkling can be from original install (or a roof recover) when water is trapped below the roof membrane. In this case we would expect hail damage to the tented areas of the wrinkles in greater proportion to the flatter roof surfaces that bear on the roof structure. There is no discernible difference between the wrinkled areas and the flatter areas as to hail impacts, therefore we conclude this wrinkling is not from initial install or pre-loss.
- Loss of energy efficiency in roof (dry fiberboard has some insulation value) wet fiberboard in area of roof cut 1, 2) places larger demand on cooling system, shortening expected service life of motors.
- Water damage to acoustical ceiling tiles requiring replacement of both damaged and undamaged tiles to match.
- Impact damage to HVAC units reducing their life and efficiency.

Cut area 1,2 (lower roof, original construction phase, wood plank / deck)

3.3 In our opinion, complete removal of the roof membrane and any water damaged fiberboard is required (cut area 1,2). If any existing fiberboard is reused additional insulation boards will be required on top of it to meet the code required R-20.

Cut area 3, 4 (expansion phase, lightweight insulating concrete, metal deck, open web steel joists)

3.4 The building code in place at the time of the loss required that roofing products shall be installed per published manufacturer's instructions. Mechanical fastener testing will be required for installation of a base sheet. In our opinion, the deteriorated LWIC is holding water that is delaying the manifestation below of the damaged roof. Water held in the LWIC roof varies based on slight differences in elevation, thickness of LWIC, locations of membrane damage, etc.

In our opinion, the deteriorated areas will be randomly distributed throughout the roof surface, these deteriorated areas will not produce the typically required 40 pound withdrawal load required by membrane manufacturers of mechanically attached base sheets (or membranes). As this would be the basic attachment surface for additional roof insulation (solidly mopped, see GAF), insulation, membrane, etc., this is not a realistic approach to repairing the roof.

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In our opinion, the deteriorated areas are either fractured, wet, or powdery. As such poor adhesion between an adhered roof system will result and a new roof applied to it will not pass the required uplift testing for roof systems in the current codes (1504.3.1).

We further note that GAF roof design considerations specifically states: "Recovering directly over an old existing roof membrane is not acceptable over a lightweight insulating concrete deck." GAF further states: "Old membranes and existing roof insulation, if present, must be removed. If the decking is suitable to receive a new roof system, the appropriate GAFMC specification must be followed."

GAF also requires topside or perimeter venting for the roofing membrane on LWIC at the rate of one per 10 squares, approximately 23 here.

In areas where LWIC is holding water, it should be removed and replaced. We suggest 50% as an estimate.

3.5 Any damage to structural elements (metal roof deck, clips, fasteners, purlins) will require sealed details from a licensed civil or structural engineer before reuse. All corroded metal decking will require special inspections during the roof replacement the replacement process. This would add a substantial cost burden to the roof replacement costs. We did not see damage to structural items during our limited inspection. We consider distressed fasteners, bottom chord joist extensions (used as braces for the bottom flange of steel framing) or decking may be discovered during repair. Damage near the corners of the roofs are the most likely to be storm-related from uplift, at least one tear.

AC UNITS

3.6 Some of these units are relatively old any may not be possible to comb the condenser coils due to embrittlement of the (aluminum) fins.

3.6.1 AC units require repair to restore to a pre-loss condition. All units should be checked. At issue is that the energy code at the time of loss requires "repairs" to meet minimum energy efficiency requirements. If these units did not meet the energy efficiency requirements at the time of the loss, repair is not allowed and the units should be replaced. Our estimate includes replacement of many of the units.

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3.6.2 We do not advocate combing of AC units due to known efficiency loss associated with the procedure for impact-damaged units. Replacement coils would be appropriate. If these coils are available, the efficiency of the unit must be checked against the current energy code for any associated minimum efficiency requirements (i.e. SEER 13). If the unit conforms, as repaired, to these requirements, it can remain in place. Units in this case are relatively old and the metal on the condenser fin coils is likely to be brittle and unresponsive to combing.

4.0 Scope of Repair:

Engineering and architectural services will be required for some portions of this project. Comply with 2009 International Building Code and Amendments otherwise.

Note: 2006 Code was in place at the time of the loss. Oklahoma has since put the 2009 IBC and IEBC in place effective November 2, 2012.

Revisions:

- 2) Replacement roof with mechanically attached base sheet. Fasteners shall be tested for 40 pound withdrawal load to satisfaction of roofing membrane manufacturer. Attach modified bitumen roof per manufacturer's specifications to base sheet.
- 9) Insulation attachment per a tested assembly is acceptable in lieu of architect's sealed drawings.

Additions:

- + Verify location and placement of vapor retarder, if required.
- + Roof vents will be required if GAF mod-bit membrane is installed here.

1504.3 Wind resistance of nonballasted roofs. Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in accordance with Section 1609.

1504.3.1 Other Roof systems. Roof systems with of built-up, modified bitumen, fully adhered or mechanically attached single-ply through fastened metal panel roof systems, and other types of membrane roof coverings shall also be tested in accordance with FM 4474, UL 580 or UL 1897.

This is a requirement for proof testing of a replacement roof.

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1504.6 Physical properties. Roof coverings installed on low-slope roofs (roof slope $< 2:12$) in accordance with Section 1507 shall demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G 152, ASTM G 155 or ASTM G 154. Those roof coverings that are subject to cyclical flexural response due to wind loads shall not demonstrate any significant loss of tensile strength for unreinforced membranes or breaking strength for reinforced membranes when tested as herein required.

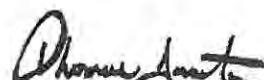
1504.7 Impact resistance. Roof coverings installed on low-slope roofs (roof slope $< 2:12$) in accordance with Section 1507 shall resist impact damage based on the results of tests conducted in accordance with ASTM D 3746, ASTM D 4272, CGSB 37-GP-52M or the "Resistance to Foot Traffic Test" in Section 5.5 of FM 4470.

These two requirements are likely already met by a majority of roofing products.

Discovery is ongoing. Additional testing and inspections may need to be performed and additional and/or supplemental information and opinions may be contained in future reports issued by Forensic Building Science, Inc. This report is the exclusive property of the client noted previously and cannot be relied upon by a third-party. Copies of this report are released to third-parties only by written permission of the client.

Please feel free to contact our office should you have any questions or need additional information.

Respectfully submitted,



Digitally signed

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February 26, 2013

Date